Maastricht UMC+
Circles of Innovation

Maastricht Cancer Center

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Foreword

As soon as you hear the diagnosis cancer, your world collapses around you. Suddenly everything is different. We help our patients to restore to their former life as well as possible. In the first instance, to offer patients an optimal chance of surviving the cancer. Besides, we also help patients to regain their old, everyday life as much as possible, together with their families, friends, colleagues, but also psychologically and emotionally. To us, this is survival with preservation of function.

Of course, prevention of cancer is the most optimal form of preservation of function. Early detection leads to a better chance of healing with less side-effects of treatment. In an advanced stage, we can adapt the treatment to the individual preferences of the patient and try and limit the severe consequences in every manner possible. Treatment and scientific research of the Maastricht Cancer Center is specifically aimed at this. Moreover, we feel it is important that our research actually leads to changes and improvements in the clinical practice. Thus we can ensure that we supply the best possible care and that tomorrow's care will be even better.

There are numerous examples as to how we put our ideas into practice. We identify which (environmental) factors may heighten the risks of contracting cancer. Through prevention we ensure that our population is less endangered by these factors. We develop and implement new methods for early detection of cancer and treatments, which have less side-effects. We develop new techniques to treat these side-effects. Simultaneously, we study how patients in their way can contribute to their own treatment and the further progression of their preservation of function.

The Circles of Innovation of the Maastricht Cancer Center, combined in this bookwork, show how our scientists and healthcare professionals collaborate and contribute to the survival of cancer with preservation of function.

Together, we create the highest oncological care and scientific innovation possible.

Prof.dr. Bernd Kremer, director Maastricht Cancer Center
Prof.dr. Manon van Engeland, scientific director of GROW – School for Oncology and Developmental Biology

Maastricht Cancer Center

In the Maastricht Cancer Center (MCC) care, scientific research and education are tightly interconnected. MCC comprises the Oncology Center and the research school GROW (School for Oncology and Developmental Biology). Moreover, a highly intensive and structural collaboration, together with the radiotherapeutic institute Maastro Clinic exists. Besides, the research schools NUTRIM (School of Nutrition and Translational Research in Metabolism) and CAPHRI (Care and Public Health Research Institute) are closely involved in the MCC scientific research.

The MCC focusses on *preservation of function*. In this way we not only refer to the frequently used term quality of life, but also to the different and most important physical, mental and social functions for each individual person. The collaboration between the above-mentioned partners contributes to this end. The approach towards a personalised treatment of patients based on clinical and biological characteristics is strongly recognised. Prevention and the progression of a healthy lifestyle is an important part of our research and our care.

Within the Oncological Network Southeast-Netherlands (OncoZON) we share our knowledge with our hospital partners in the region and make mutual use of each other's expertise. In this way the patient can benefit from the best possible care close to home. Thus within OncoZON we form a joint oncological network to guarantee the oncological quality of care in Southeast-Netherlands for today and in the future.

MCC is part of the Maastricht University Medical Center+ (Maastricht UMC+). This is the name under which the Maastricht University Hospital (azM) and the Faculty of Health, Medicine and Life Sciences (FHML) of Maastricht University cooperate. The mission statement of Maastricht UMC+ is *'Providing the best possible healthcare and improving health in the region by integrating patient care, research and education.'* All of us work on this task with passion and total dedication.

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Circle of Innovation: Primary prevention of cancer

MAASTRICHT UMC+ CONTRIBUTES TO CANCER PREVENTION THROUGH HEALTHY LIVING

+ We improve awareness of lifestyle for cancer prevention in the population, healthcare professionals and trainees.
+ We provide personalised dietary advice in combination with innovative foods to reduce cancer risks.
+ We are steering committee member of the Cancer Prevention Europe consortium aimed at reducing morbidity and mortality from cancer in European populations through prevention.

INCREASING AWARENESS FOR CANCER PREVENTION

+ Our knowledge contributes to prevention recommendations of the World Cancer Research Fund, risk assessments of the European Food Safety Authority and to defining the carcinogenicity of agents by the International Agency for Research on Cancer.
+ We collaborate with food industry to innovate processing technologies to reduce the risk of cancer.

HEALTHY DIET AND LIFESTYLE REDUCE THE RISK OF CANCER

+ We showed that a healthy diet or lifestyle influences the risk of cancer depending on genetic susceptibility and molecular subtypes of cancer, for example, a Mediterranean diet protects against the hard-to-treat hormone receptor negative breast cancer.
+ We demonstrated that combinations of bioactive ingredients in fruits and vegetables can be optimised to improve their cancer preventive effects.

RISK ESTIMATION THROUGH PREDICTION MODELING

+ With our knowledge we better understand the importance of diet and lifestyle for cancer risk.
+ We have developed prediction models, including lifestyle factors, to predict the risk of developing cancer.
+ On the basis of our prediction models we are developing lifestyle interventions and food products containing smart combinations of ingredients for personalised cancer prevention.

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Circle of Innovation: Cancer prevention by personalised nutrition

LIFESTYLE CHANGES REDUCE CANCER RISK

+ Increasing awareness is being created about the impact of diet and lifestyle on cancer risk amongst care givers and general population.
+ Quality of life is improved as a consequence of personalised dietary and lifestyle advises.
+ By designing new food products with optimal combinations of bioactive ingredients it is easier to adapt a healthy diet.

EVIDENCE-BASED CHANGES IN FOOD PRODUCTION

+ We created new food products that have proven health promoting effects using our understanding of synergistic effects of food ingredients.
+ A new meat processing concept has been developed that reduces the diet induced exposure to carcinogenic substances.
+ Personalised dietary advice is given based on scientific data.

HEALTHY NUTRITION REDUCES CANCER RISK

+ We have demonstrated that bioactive compounds in fruits and vegetables stimulate cancer preventive processes.
+ Differences in genetic make-up are found to contribute to the inter-individual variation in such protective effects.
+ Combining health effect markers with big data generates new insights in the molecular mechanisms underlying cancer preventive effects.

TAYLOR-MADE NUTRITIONAL ADVICE

+ We identified optimal combinations of bioactive compounds for specific target groups.
+ Using a personal monitoring system we will generate insight in the effects of food products that contain specific combinations of ingredients.
+ Tailored nutritional advice will be given based on genetic screening and real-time effect monitoring.

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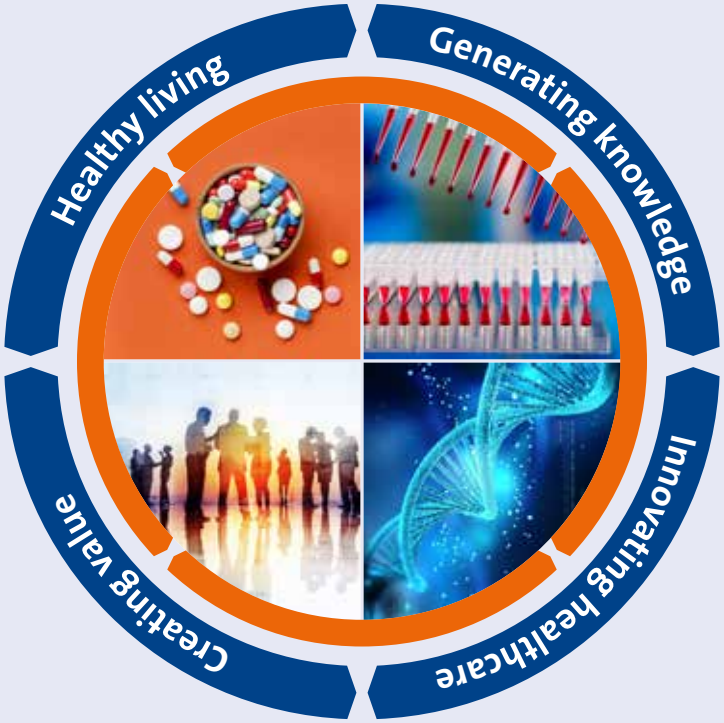
Circle of Innovation: Drug safety

PERSONALISED MEDICATION CONTRIBUTES TO A HEALTHIER LIFE

+ Selection of the right medication and dose will contribute to improved quality of life and preservation of function.
+ Personalised medication will result in less complications and improved recovery after chemotherapy.
+ New therapies that have less side effects will become more readily available as a consequence of our research.

TOXICOGENOMICS CAN CONTRIBUTE TO DRUG SAFETY

+ We are contributing to the development of prediction models for the pharmaceutical industry.
+ We stimulate the early identification of drugs that have an increased risk of side effects.
+ We contribute to the reduction of costs for the development of new pharmaceuticals.
+ Our expertise can be used to reduce the attrition rate of pharmaceuticals due to toxicity.



UNDERSTANDING TOXICITY CAN REDUCE SIDE EFFECTS OF DRUGS

+ Toxic side effects of chemotherapy can result in termination of the treatment and reduced quality of life.
+ We can predict toxicity at an early stage using gene expression profiles.
+ We are developing blood-based biomarkers for organ toxicity.
+ We can identify mechanisms that explain idiosyncratic drug responses and individual susceptibility.

USING INSIGHT IN TOXIC MECHANISMS TO IMPROVE ANTI-CANCER THERAPY

+ We are developing genomics-based personalised strategies that take individual susceptibility into account.
+ Our methods allow to predict toxicity of new drugs in the early phases of drug design and development.
+ Our genomics biomarkers can be used to monitor for toxicity during pharmacotherapy in a more sensitive way.

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Circle of Innovation: Promoting respiratory health

URBAN DESIGN HAS AN IMPACT ON HUMAN HEALTH

+ Implementation of technical and policy-based interventions can reduce human exposure to air pollution.
+ We have demonstrated that reduced exposure results in measurable effects on relevant health outcome parameters.
+ Urban planners can use the outcome of our monitoring system to design healthier cities and identify hotspots that require redesigning.

AIR POLLUTION INCREASES LUNG CANCER RISK

+ We developed a new method to characterise ambient particulate matter in terms of health risks.
+ We demonstrated that the radical generating capacity of airborne particulates is associated with the induction of DNA damage and mutagenicity.
+ Radical generating capacity of particulates is associated with reduced lung function in children.

IMPROVED METHODS TO CHARACTERISE AIR QUALITY

+ We developed methods that can be used to measure radical generating capacity of air pollution.
+ These methods are being adapted in monitoring systems at a number of municipalities in the Netherlands (Zwolle, Venlo, Eindhoven, Maastricht).
+ Our methods allow for the evaluation of the effectiveness of intervention-strategies aiming to improve urban air quality.

IMPROVED HEALTH RISK ASSESSMENTS USING BETTER BIOMARKERS

+ We identified better markers to identify health risk hotspots in urban areas based on radical generating capacity.
+ These measurements can also be used to characterise indoor exposures.
+ Exposure assessments can be used to make decisions on cost-effective interventions for more susceptible subpopulations.

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Circle of Innovation: Preservation of function through (p)rehabilitation

FITNESS LEADS TO LESS COMPLICATIONS AND PRESERVATION OF FUNCTION

- Elderly patients are often vulnerable leading to decreased tolerance of aggressive oncological treatment.
- Adaptation of lifestyle (physical activity, nutrition, smoking cessation) increases fitness, resulting in improved treatment tolerance and earlier recovery, inducing a better quality of life and preservation of function.

SURVIVING WITH PRESERVATION OF FUNCTION

- Through the results of our research and in collaboration with the patient, a multidisciplinary and feasible lifestyle programme to be implemented in daily life is developed.
- This kind of lifestyle programme is expected to lead to improved treatment tolerance and preservation of function.

HOW CAN LIFESTYLE BE ADAPTED IN ELDERLY PATIENTS?

- It is assumed that (p)rehabilitation (improving physical fitness before, during and after treatment of cancer) leads to less complications in vulnerable elderly patients.
- Thus, more elderly patients are able to tolerate advised treatment.
- Research is conducted concerning effectiveness of the lifestyle programme as well as feasibility and adherence.

FEASIBLE AND PERSONALISED LIFESTYLE PROGRAMME

- An effective and feasible lifestyle programme for elderly patients is developed.
- Within this programme there is multidisciplinary and transmural collaboration.
- We have created first evidence that this lifestyle programme makes improved treatment tolerance and earlier recovery possible. This results in a better quality of life and preservation of function.

Circle of Innovation: Oncology rehabilitation: exercise and nutrition

PRESERVATION OF FUNCTION WITH TAILORED TREATMENT

- Due to improvements in treatment modalities, the amount of cancer survivors is increasing.
- However, treatment often leads to loss of muscle mass and strength, resulting in loss of daily functioning and increased risk of comorbidities.
- Individually tailored rehabilitation programs support patients to improve their health and preserve their daily functioning during and after treatment.

INDIVIDUALLY TAILORED REHABILITATION PROGRAMS

- Our metabolic knowledge on muscle mass preservation during aging and disease enables us to design evidence-based individually tailored rehabilitation programs.
- We aim to provide every cancer patient with personalised advice on exercise and nutrition.
- Our technique to design individually tailored rehabilitation will be incorporated in (inter)national oncology guidelines.

FIT FOR TREATMENT

- We study whether metabolic profiling of oncology patients before treatment offers insight into their risk of complications and comorbidities during different treatment modalities.
- In addition, we develop exercise and nutritional interventions to maintain patients' muscle mass and strength during cancer treatment.
- Furthermore, we study the direct effect of exercise and nutrition on tumour growth.

REHABILITATION TO IMPROVE TREATMENT OUTCOMES

- Using exercise training and nutritional interventions we aim to increase muscle mass before, during and after cancer treatment.
- Exercise and nutritional interventions are used to enhance treatment outcomes and decrease complications and side effects.
- Rehabilitation programs increase patients' knowledge on healthy living, which decreases cancer recurrence or comorbidities.

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Circle of Innovation: New causes of hereditary breast and ovarian cancer

GENETIC COMPASS FOR HEALTHY LIVING

+ Knowledge of the human genome helps us to predict cancer risk. This risk can be lowered by increasing the frequency of health check-ups, changes in life style and preventive surgery.
+ Based on genetic information we can choose the most effective treatment for cancer with minimal side effects.
+ Using embryo selection we try to prevent the birth of children with a strong genetic cancer-predisposition.

ADDED VALUE OF KNOWING THE CAUSE OF HEREDITARY CANCER

+ We can test healthy relatives for familial genetic risk factors. When risk factors are present, these relatives can act effectively to prevent cancer onset. Thus reducing human suffering and the costs brought about by this disease.
+ The next generation can be freed from the burden of cancer-predisposition by embryo selection.

SEARCHING FOR NEW CAUSES OF HEREDITARY BREAST AND OVARIAN CANCER

+ We are able to determine the DNA sequence of a complete human genome, but clinical interpretation is mainly limited to the small protein-coding part (1.5%).
+ Analysis of this small part of the genome detects the genetic defect in maximal 20% of hereditary breast and ovarian cancer families.
+ To find new causes of hereditary breast and ovarian cancer, we study the functional effect of genetic variation in the entire genome on RNA expression and splicing.

INNOVATIVE TREATMENT

+ With our growing knowledge of the genome in relation to cancer onset, we can give a more personalised cancer treatment. This is more effective and reduces recurrence risk.
+ The reduced recurrence risk is in line with the current effective use of PARP-inhibitors for ovarian cancer treatment in women with a BRCA1 or BRCA2 mutation.

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Circle of Innovation: Innovative liver surgery in the new era

COMPLICATIONS PREVENTED BY GOOD CONDITION OF THE PATIENT

+ We are the largest liver resection centre of the Netherlands, 150 patients per year.
+ We are a fourth line referral centre for initial non-resectable liver tumours.
+ We perform extensive research to optimise the condition of the patient before surgery. Preoperatively, the patient is trained by a physical therapist and dietary advice is given to improve liver function.

INTENSIVE ACADEMIC COLLABORATION

+ Together with the RWTH Aachen we form ESCAM, European Surgical Center Aachen-Maastricht
+ We are leading OncoCare: a Euregional cooperation in order to optimise the care around the liver surgery patient.
+ We are fellow patent holder of the stimulation of liver regeneration by means of activating organellar bile salt receptors.
+ We have developed a test for markers of new biliary damage for faster and better diagnosis.

LIVER FUNCTION OPTIMISATION

+ Maastricht UMC + does a lot of research into the preservation of liver function to limit the damage of chemotherapy (nodular regenerative hyperplasia and sinusoidal obstruction syndrome).
+ We are busy developing new drugs to prevent post-operative liver failure and to promote liver regeneration.
+ We are investigating and optimising imaging in relation to function e.g. imageJ volumetry compared to pathology examination after resection.
+ Using radiomics we try to predict the outcome of a surgical patient to the surgeon.

PRECISION SURGERY

+ We have developed the iKnife and use it in a research setting. The iKnife is a surgery-real time tool with which the border of the tumour can be measured thereby increasing accuracy in surgery.
+ We lead three global studies into the safety and value of liver resections using keyhole surgery.
+ Based on our research is the timing of neo-adjuvant chemotherapy adjusted to minimise liver damage and to optimise postoperative liver function.

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Circle of Innovation: Innovation of soft tissue sarcomas treatment

OPTIMISATION PRESERVATION OF FUNCTION

+ We are a NFU (Netherlands Federation of University Medical Centres) recognised Sarcoma Centre with a strong focus on preservation of function.
+ Through clinical and scientific cooperation with plastic surgeons, we can use microsurgical techniques to include innervated muscle flaps thus maintaining physical function.
+ We extensively discuss and implement the use of systemic therapy to avoid toxicity and to preserve function.

LEAGUE-LEADER FOR (INTER) REGIONAL COOPERATION

+ We have a fully-fledged multicentre and multidisciplinary soft tissue consultation set-up in Southern Netherlands to improve diagnostics, treatment, optimisation and streamlining care for patients.
+ We are part of the Dutch Sarcoma Group thereby gathering available data for research to provide and share our data with other research groups.
+ We are developing a national platform to discuss complex cases around sarcomas.

OPTIMISATION DIAGNOSTICS TUMOUR

+ With the iKnife (using mass spectometric imaging for tissue profiling during electrosurgery) we can in real time determine properties and profiles of sarcomas, and improve diagnostics.
+ We investigate improvement of radiological diagnostics with PET-MRI, PET-CT, radiomics and diffusion Weighted Imaging.
+ We are looking for indications for proton treatment.
+ We do research to characterise tumours based on imaging with radiomics.

IKNIFE IN RESEARCH SETTING

+ Using the iKnife we can remove a tumour more accurately thereby sparing more vital tissue without compromising the oncological outcome.
+ We extend our studies in a European context with the European Organization for Research and Treatment of Cancer.
+ To ensure optimal preservation of function we use radiotherapy, stereotactic body radiation therapy and proton therapy to minimise the damage to surrounding healthy tissue.

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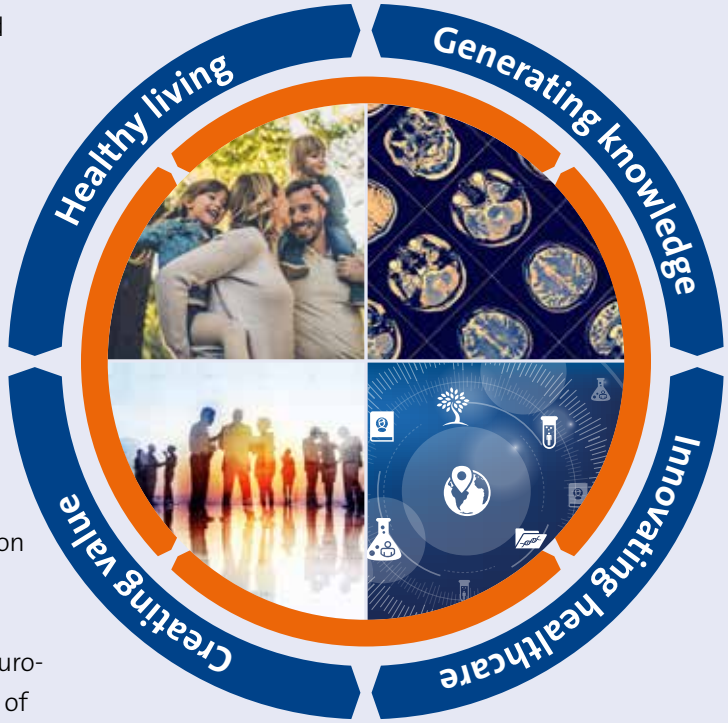
Circle of Innovation: Brain tumours

REDUCING SIDE EFFECTS AND MAINTAINING FUNCTIONS

+ Our glioma centre is certified by NFU (Netherlands Federation of University Medical Centres) to treat primary brain tumours.
+ The multimodal treatment of brain tumours is complex. A team of nurses, (neuro)psychologists and social workers support our patients and caregivers.
+ We develop novel therapies to prolong overall survival with maximal preservation of function and quality of life.
+ We promote social and professional reintegration of our patients by physical and neuro-psychological revalidation.

SOCIETAL IMPACT: EDUCATION, GUIDELINES, PUBLIC AWARENESS

+ We collaborate on both national and international levels in order to acquire new knowledge, participation in new clinical trials and treatment options to our brain tumour patients.
+ We play an active role in the Dutch and European neuro-oncology society and participate in the development of treatment guidelines for patients with brain tumours.
+ We organise neuro-oncology training for both medical and paramedical professionals. We invest in PhD projects that create preclinical and translational rationale for the development of innovative-investigator driven-multicentre clinical trials.



PREDICTIVE MODELS AND TUMOUR TAILORED TREATMENT PLANS

+ We develop both organoid platforms and in vivo tumour models of high grade gliomas for our research.
+ Using novel imaging techniques (e.g. 7T MRI, hybrid PET-MRI) and computer algorithms (e.g. radiomics, deep learning), we correlate imaging features with the molecular fingerprint of primary brain tumours to predict prognosis and treatment response.
+ We optimise our treatments, with e.g. proton therapy, to minimise damage of healthy brain tissue.
+ We develop 'Normal Tissue Complication Probability' models to reduce side effects of brain irradiation.

GLIOMA CLINICAL TRIALS: FROM BENCH-TO-BEDSIDE

+ We translate our preclinical research toward innovative clinical trials for glioma patients, using promising new drugs, like hypoxia activated prodrugs and repurposed drugs.
+ Using shared decision tools, our patients become active partners in the creation of patient tailored treatment plans.
+ With highly innovative neurosurgical procedures and novel radiation including proton therapy, we prevent therapy induced loss of brain function.

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Circle of Innovation: Lung cancer and thymus tumours

IMPROVEMENT OF QUALITY OF LIFE

+ Maastricht UMC+ is an expert centre for targeted therapy in favour of lung cancer patients with a driver mutation, with small-cell lung cancer, with carcinoids and with thymus tumours.
+ As regards to treatment, we choose the best combination of radiotherapy, medication and surgery.
+ We develop multifactorial prognostic models for better survival with preservation of function.
+ In our proton therapy centre, we can treat tumours with a high degree of precision.

PRESERVATION OF FUNCTION

+ We offer innovative targeted medicines, immunotherapy against lung cancer and thymus tumours, 'state-of-the-art' radiotherapy, including proton therapy, liquid biopsies to prevent invasive biopsies, all leading to less adverse effects.
+ We investigate the effect of cancer treatments on metabolism and the heart. To reach the patient more quickly, we work together with companies to enable these innovations.

IMPROVEMENT THERAPEUTIC RATIO

+ We use both primary tumour and normal cell lines and tissue models (organoids) to study intra- and intertumour heterogeneity and predictive markers for response.
+ We investigate new and existing ('repurposed') targeted drugs, pRb IHC/mutation analysis for large cell neuroendocrine carcinoma and its therapy.
+ We define high precision radiotherapy using molecular imaging of tumours and healthy tissue.

NEW TREATMENT OPTIONS FOR LUNG CANCER PATIENTS

+ Preclinically we test new therapies that modulate the microenvironment of the tumour and unravel the genetic background.
+ In patient studies we combine chemo-radiotherapy, targeted therapies, immunotherapies and hybrid precision surgery for the best treatment.
+ We investigate new methods for early detection and treatment of brain metastases with fewer side effects and neuro-cognitive decline.

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Circle of Innovation: Thyroid cancer

TREATMENT OF THYROID CANCER IN THE REGION, BOTH NATIONALLY AND INTERNATIONALLY

+ The incidence of thyroid cancer is increasing worldwide.
+ To guarantee best quality care, OncoZON network signifies consensus about treatment and care for patients with thyroid cancer.
+ Maastricht UMC+ is assigned as centre of expertise for thyroid cancer within the European Reference Network (ERN).
+ We work in multidisciplinary teams with structured work-up, and shared decision-making to optimise both physical and psychological wellbeing of each patient.

INTENSIVE COLLABORATION

+ We developed standardised regional protocols in OncoZON, moreover we have a fruitful collaboration with Aachen.
+ We offer complex multidisciplinary care for thyroid carcinoma patients in Maastricht UMC+ in addition to an optimisation of the chain of care with the focus on diagnostics and treatment and attention for quality of life.
+ We have intensive collaboration with the patients association (SON) and organise patient information events on a regular basis to share best practises.

RESEARCH FOR EXCELLENT CLINICAL CARE

+ Maastricht UMC+ is a 'state-of-the-art' university medical centre with cutting-edge endocrine and surgical care.
+ We have excellent nuclear medicine, oncology, radiology and pathology facilities to deliver first class clinical care.
+ Our recently developed methods of imaging and molecular markers are increasingly used in clinical care.
+ We perform both clinical and translational research with a main focus on diagnosis and the specific identification of high risk patients for recurrence.

FAST TRACK DIAGNOSTICS AND CHAIN CARE

+ Our pathology is excellent by combining molecular markers and standardised ultrasound.
+ We develop innovative diagnostic tools e.g. the eNose© using artificial neural network technology, and nuclear imaging methods based on the use of new compounds in PET imaging.
+ To improve our care, we coach patients focusing on quality of life, have an endocrine nurse function as the key coordinator and gather data in a prospective database and biobank.

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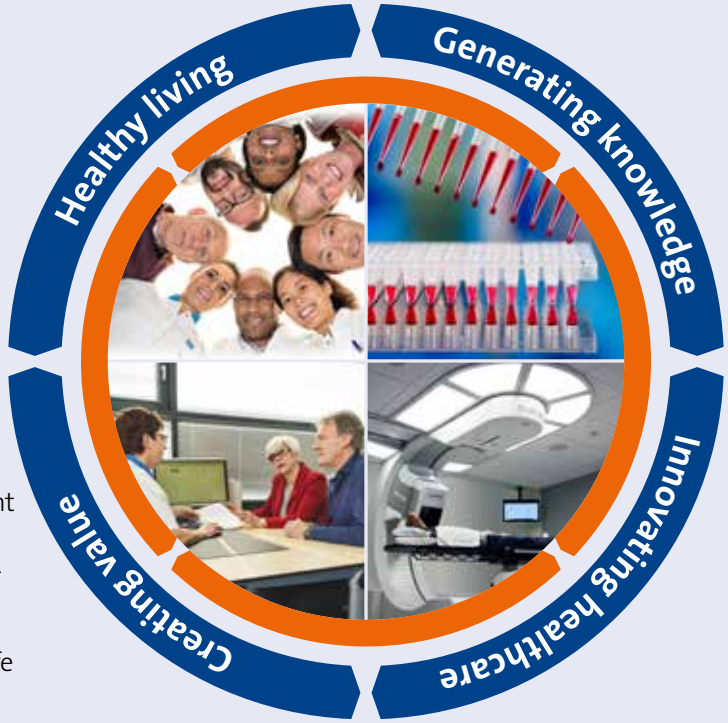
Circle of Innovation: Head and neck oncology: surviving with preservation of function

A PHYSICALLY AND MENTALLY HEALTHY LIFE AFTER CANCER TREATMENT

+ Patients with skin cancer and larynx cancer are treated respectively with Mohs- and CO2 laser surgery. This is a radical surgery with maximum preservation of function.
+ We use multidisciplinary revalidation after cancer therapy supervised by a social worker. We offer swallowing and speech rehabilitation performed by a speech therapist. We adopt oral rehabilitation by a special dentist, and opt voor guidance and coaching by a nutritionist.

PRESERVATION OF FUNCTION

+ Our fast-diagnosis shortens diagnostic and treatment waiting lists which improves survival.
+ We implement biomarkers for a better estimation of cancer development, change of recurrence, bone invasion, person tailored therapy, better quality of life and more preservation of function.
+ We involve patients in shared decision-making concerning therapy options.



IMPROVE TREATMENT OUTCOME

+ We investigate the late effects of radiotherapy on the development, treatment and prevention of osteoradionecrosis.
+ With molecular (genetic) research of tumours and their microenvironment we are more apt to predict tumour development, behaviour and response to therapy.
+ We identify predictive models for oncological outcome and therapy side effects including tumour- and blood biomarkers, HPV, genomics and radiomics.

INNOVATIONS WITH FAST IMPLEMENTATION

+ We do (pre)clinical testing of new targeted therapies in combination with (proton)radiotherapy.
+ We use patient specific implants for reconstructions. This saves time, has a better functional recovery and predictable outcome.
+ We use photodynamic therapy if surgery or radiation therapy is not possible or desired. Herewith we have a lower morbidity and improved quality of life.

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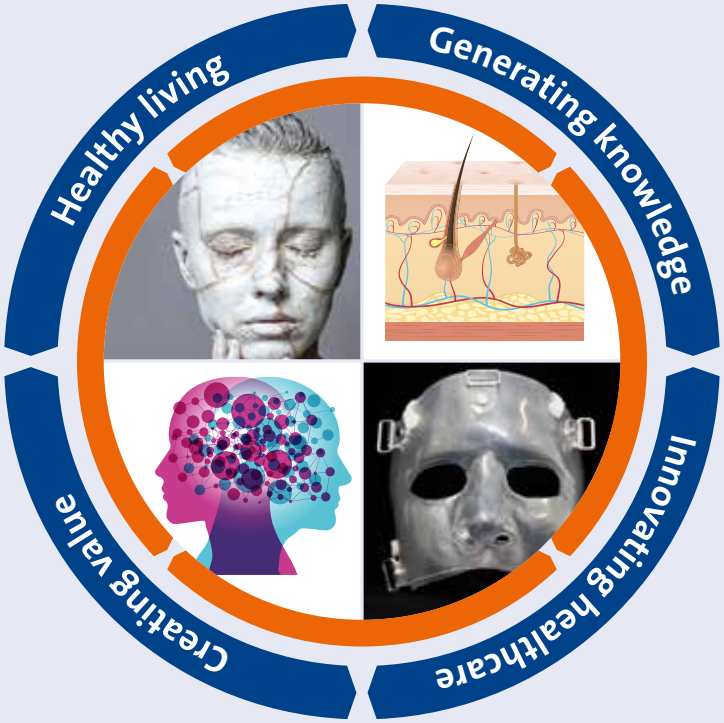
Circle of Innovation: Scar treatment

LESS SURGERY THROUGH SCAR TREATMENT

+ Maastricht UMC+ performs innovative scar treatment using compression and occlusion to prevent secondary surgery in oncological reconstructive surgery.
+ Less pain medication is needed as a result of conservative scar treatment after reconstructive surgery thus increasing quality of life.
+ Early intervention decreases the risk of hypertrophic scars, resulting in increased preservation of function, recovery and rehabilitation.

BETTER OUTCOME, BETTER COSMETIC RESULT

+ We developed a patented skin press system for scar treatment.
+ Due to additional treatment of scars with pressure and occlusion, the quality of scars as evaluated by doctors and patients is increased.
+ Cosmetic outcome in reconstructive surgery in combination with conservative scar treatment is increased resulting in improved quality of life.
+ Healthcare costs are decreased due to prevention of hypertrofic scars and keloids.



UNDERSTANDING SCAR AND WOUND HEALING

+ We perform clinical and outcome research in maturation of scars.
+ This is the basis of our understanding of scar treatment.
+ We use pressure measurements for a better understanding of the amount of pressure in relation to maturation of scars.
+ Due to our knowledge, we are the national referral centre for scar treatment.

INNOVATIVE TREATMENT

+ Due to more extensive reconstructive surgery as a result of increased incidence of facial skin cancer, we confront more complex scars.
+ Using our knowledge, we are able to develop custom made pressure masks. This is beneficial for the treatment of these complex scars.
+ Further development of the pressure mask increases the final result. By remote regulation of pressure, we obtain a better follow up.

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Circle of Innovation: Skin cancer

SKIN CANCER IS THE MOST COMMON MALIGNANCY

+ Some 70.000 new skin malignancies are diagnosed yearly in the Netherlands.
+ Over 2.000 non-melanoma skin cancer patients visit our department yearly.
+ Almost all high stage non-melanoma skin cancer of southern part of the Netherlands are referred to the Maastricht UMC+.
+ Based on our research, we provide individualised treatment for our patients to achieve the best possible outcome with preservation of function.

PRESERVATION OF FUNCTION DURING TREATMENT AND DIAGNOSTIC

+ We improve skin conservation in treatment of facial skin cancer. An optimal example of preservation of function.
+ We investigate the accuracy of non-invasive diagnostics with optical coherence tomography in non-melanoma skin cancer to decrease the number of invasive biopsies.
+ Online tools are developed to help patients choose between invasive and non-invasive treatments of non-melanoma skin cancer.
+ We developed guidelines based on our research.

DEVELOP MOST EFFECTIVE DIAGNOSTICS AND TREATMENT

+ New genetic screening tools are developed for advanced tumours and familial skin cancer syndromes.
+ We perform genetic analysis on advanced basal cell carcinoma.
+ This enables selective use of targeted treatment and aids in the development of new therapies.

CLINICAL EVALUATIVE AND INNOVATIVE RESEARCH

+ With randomised controlled multicentre trials we compare different registered treatments of non-melanoma skin cancer.
+ Using the results of our trials, new treatment strategies are developed for non-melanoma skin cancer.
+ We validate prediction models for identification of high risk patients.

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Circle of Innovation: Sentinel node in ovarian cancer

IMPROVED QUALITY OF LIFE THROUGH MORE TARGETED SURGICAL INTERVENTION

+ In patients with clinical early stage ovarian cancer, a surgical staging procedure is recommended, which includes a pelvic and para-aortic lymph node dissection to identify occult lymph node metastases (15%).
+ A sentinel node procedure could prevent surgical related morbidity being caused by the lymphadenectomy.

PRESERVATION OF FUNCTION FOR AN INCREASED QUALITY OF LIFE

+ Maastricht UMC+ has a leading role in initiating (inter)national consortium studies on the significance (accuracy) of sentinel node detection in ovarian carcinoma.
+ All this leads to a better quality of life due to less surgical related morbidity, such as lymph edema, preservation of function and improved survival.

LYMPHATIC DRAINAGE PATHWAYS OF THE OVARY

+ Maastricht UMC+ is developing a technique during surgery to identify sentinel node(s) in early stage ovarian cancer.
+ For this purpose we have examined the lymph drainage pathways of the ovary and fallopian tubes which run invariably via both ovarian ligaments.
+ These findings support the strategy of injecting tracers in both ovarian ligaments to identify sentinel nodes.

MORE EFFECTIVE SURGICAL INTERVENTION

+ During a pilot study, we injected tracers in both ovarian ligaments, and so identified 'hot' lymph nodes in all cases, the location correlating well with the location of lymph node metastases in patients with clinical early stage ovarian cancer.
+ Using the sentinel nodes procedure, we can limit ourselves in the resection of lymph nodes in malignant ovarian tumours.

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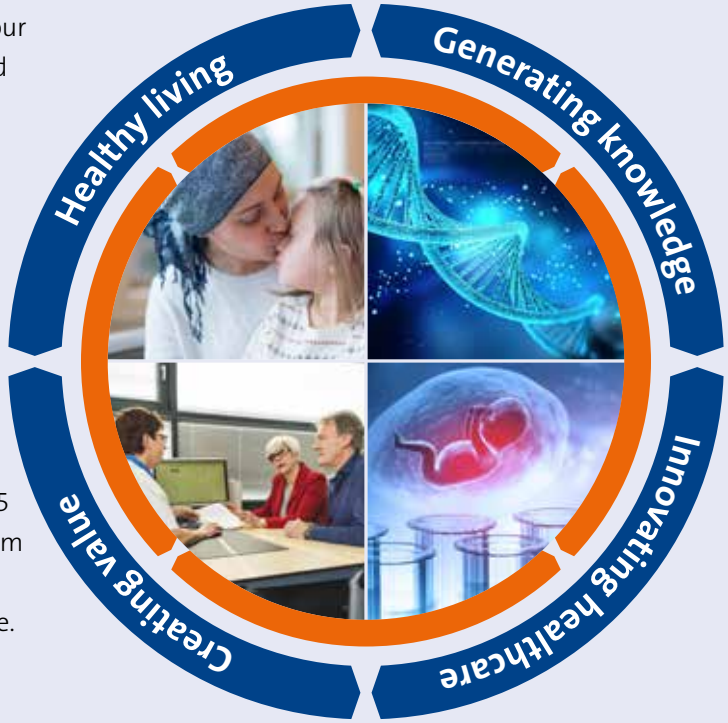
Circle of Innovation: Breast cancer at young age

LIFE DURING AND AFTER BREAST CANCER

+ Breast cancer is the leading cause of death among women aged 30 to 50 years. These women are amidst their working, social and family life.
+ Shared decision-making and intensive guidance by our breast cancer team improves patient acceptance and satisfaction as also of their closest kin.
+ Survival is the main goal. However, preservation of function, maintaining quality of life, breast contour, shoulder- and arm function, and fertility deserve our utmost attention.

TO DECIDE TOGETHER AND DO TOGETHER

+ We proudly receive the Pink Ribbon every year. In 2015 we even received the prize for best Breast Cancer Team by Libelle, a women's lifestyle magazine.
+ Personal wishes of the patients are central in our care. We promote shared decision-making by a self-developed choice guide, and we offer a personalised care plan when primary treatment is finished.
+ Knowledge exchange takes place with the regional OncoZON breast cancer team.
+ Our breast cancer team is internationally known for our contribution to new developments.



BIOMARKERS AND PROFILES

+ Breast cancer is a heterogeneous disease. With DNA profiling of the tumour, we can increasingly identify specific breast cancer subtypes.
+ We accurately visualise the tumour by molecular tracers and combined imaging techniques.
+ These new insights offer the best chance of cure with the least risk of (long-)term side effects.
+ New drug therapies become more effective, and are used more effectively guided by new biomarkers.

TAILORED TREATMENT

+ To ensure future family planning, we offer both cryopreservation of oocytes and embryos before the start of chemotherapy.
+ Our breast team optimises armpit-saving treatments to preserve shoulder and arm functions.
+ Our innovative breast reconstruction techniques with autologous tissue are further developed and refined.
+ Proton therapy makes radiation therapy more accurate with less chance of irreversible radiation-induced injury.

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Circle of Innovation: Node metastases in breast cancer patients

LIFE AFTER BREAST CANCER

+ Axillary staging is part of breast cancer treatment.
+ Currently imaging staging misses 50% of nodal metastases. This leads to a necessary staging operation.
+ In case of metastases, surgery or radiotherapy is recommended.
+ Staging and treatment result in complications, like lymphedema, chronic pain and shoulder dysfunction, which negatively impact quality of life.
+ These effects urged us to perform our research to increase quality of life.

BETTER PRESERVATION OF FUNCTION AFTER BREAST CANCER

+ Improved staging information with imaging results in patient-tailored treatment, instead of 'one-shoe-fits-all'.
+ Using our techniques, we have a decreased morbidity with equal survival and better preservation of function.
+ Patients have an improved quality of life, due to less limitations resulting from lymphedema or impaired shoulder function.
+ Our knowledge is presented worldwide and adopted in the Dutch Breast Cancer guideline.

OPTIMAL IMAGING TO OMIT THE STAGING OPERATION

+ Using our research, we gain maximum benefit from techniques already in use such as MRI.
+ We introduced novel techniques to improve nodal imaging, namely contrast enhanced MRI and PET-MRI.
+ We apply innovative techniques for example radiomics and rapid learning to translate the enormous amount of (hidden) information within images into meaningful conclusions.
+ We research the value of omission of the sentinel node in case of specific type of breast cancer.

OPTIMAL IMAGING TO OMIT AXILLARY SURGERY

+ Through personalised decision making on axillary staging and treatment, we prevent overtreatment without impairing survival.
+ Neo-adjuvant systemic therapy and improved response evaluation adds to the knowledge about further regional therapy.

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Circle of Innovation: Breast reconstruction

SENSATION IN THE RECONSTRUCTED BREAST

+ Maastricht UMC+ is specialised in breast reconstruction using own tissue.
+ We consider breast sensation as an essential part of the reconstruction for the preservation of function.
+ We are the first hospital in the Netherlands where sensate flaps are used for breast reconstruction.
+ Our goal is to give our patients a breast that feels like their own breast.

QUANTIFICATION OF SENSATION

+ Sensation in the breast is a complex issue including functional aspects like touch, pain, temperature.
+ Maastricht UMC+ improves nerve reconstruction techniques in autologous breast reconstruction.
+ Qualitative and quantitative analyses are done based on approved questionnaires and touch-measurements with Semmes-Weinstein monofilament, pressure specified sensory device and quantitative sensory test (temperature and pain).

BETTER SENSATION FOR A BETTER QUALITY OF LIFE

+ A better sensation in the reconstructed breast improves our patients' quality of life and is a beautiful example of preservation of function.
+ Sensation in a reconstructed breast is important psychologically but also to protect against skin injuries like burns.

NEW TECHNIQUE TO IMPROVE THE SENSATION IN A RECONSTRUCTED BREAST

+ We analyse the individual meaning of breast sensation in women with qualitative research.
+ Nerve reconstruction is done through the coaptation of two nerve branches (1 mm in diameter) under the microscope.
+ The operation takes only 20 minutes longer, without risks or extra complications to the procedure.

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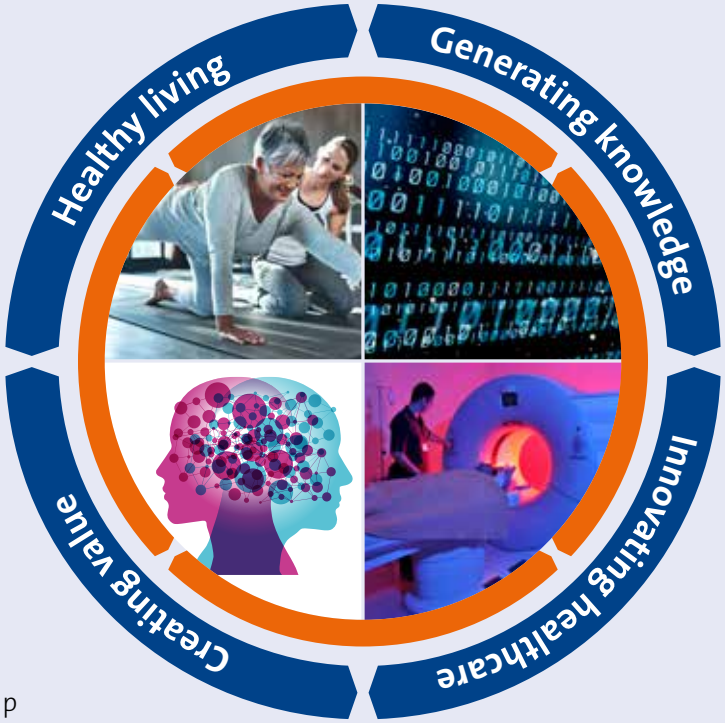
Circle of Innovation: Breast cancer imaging

PRESERVATION OF FUNCTION THROUGH IMPROVED IMAGING AND HEALTHCARE OPTIMALISATION

+ Maastricht UMC+ performed non-invasive imaging of axillary metastases using PET-MRI.
+ We optimise imaging for response monitoring of breast cancer patients treated with neoadjuvant chemotherapy.
+ We continuously work on improving contrast-enhanced mammography and discover its indications as replacement for MRI.

IMPROVEMENT OF PRIMARY BREAST CANCER DIAGNOSTICS AND STAGING

+ We are the first Dutch centre to install contrast-enhanced mammography and hybrid PET-MRI techniques.
+ We continuously work to improve PET-MRI sequence protocols, aiming to develop a more accurate method for response monitoring of patients treated with neoadjuvant chemotherapy. Preservation of function is a point of focus.



OPTIMAL KNOWLEDGE EXCHANGE THROUGH COLLABORATIONS

+ Maastricht UMC+ is considered a centre of contrast-enhanced mammography expertise.
+ We improved efficiency of care by using contrast-enhanced mammography in women recalled from breast cancer screening (RACER study).
+ By participation in (inter)national committees we help to improve breast cancer care.
+ We attempt to implement contrast-enhanced mammography within the national guidelines but also participate in the American College of Radiology BI-RADS lexicon.

INNOVATIVE DIAGNOSTICS AND IMPLEMENTATION OF NEW HEALTHCARE PATHWAYS

+ We developed a treatment plan per individual based mainly on contrast-enhanced mammography of women recalled from breast cancer screening (RACER study).
+ We propose novel treatment options and diagnostics for women with axillary metastases, based on advanced PET-MRI solutions.

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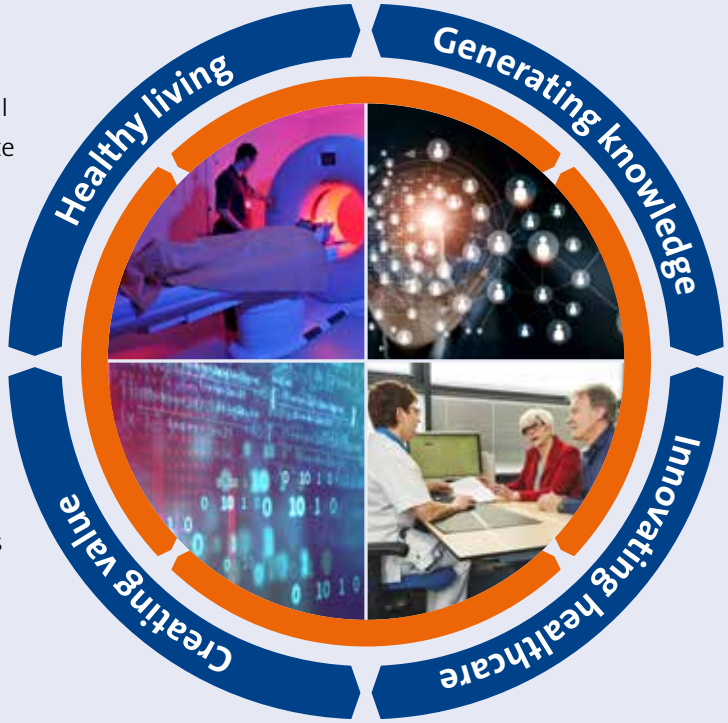
Circle of Innovation: Advanced diagnostic imaging approaches

CONTINUOUSLY IMPROVING DISEASE DETECTION

+ We are continuously improving primary staging and early detection of oncological disease.
+ We combined PET-MRI with anatomical details as well as functional information. This impacts significantly our therapy management.
+ We use ultra-high field MRI as well as hybrid PET-MRI to improve early detection of disease and to delineate early therapy response. Our innovative image processing using data mining, deep learning and radiomics brings us improved prediction models to establish individualised therapy concepts.

CHANCES FOR THE FUTURE

+ We are implementing non-invasive imaging to focus on individualisation of image-guided therapies employing artificial intelligence to enhance cost efficiency.
+ Maastricht Imaging Valley combines all available imaging methods and thereby supports clinical and translational research.
+ We expect that our multidisciplinary and multimodal approaches are the biggest chances in clinical and translational research. In combination with sophisticated data mining strategies, we offer personalised disease management.



DEVELOPING NEW IMAGING PROTOCOLS

+ We discovered that hybrid imaging and the combination of top-notch imaging methods offers the opportunity to early detect the most efficient therapeutic options earlier than conventional imaging approaches.
+ We develop new imaging protocols and sequences as well as artificial intelligence based models to enhance and translate this knowledge to clinical practice.

USING MULTIPARAMETRIC DATA

+ Functional information on individual level will deliver early insight in the most efficient therapy for the individual patient. An important aspect is the preservation of function.
+ We are using multiparametric data which leads to an advancement of individual disease management. An important aspect is the support of less invasive but equally safe approaches.

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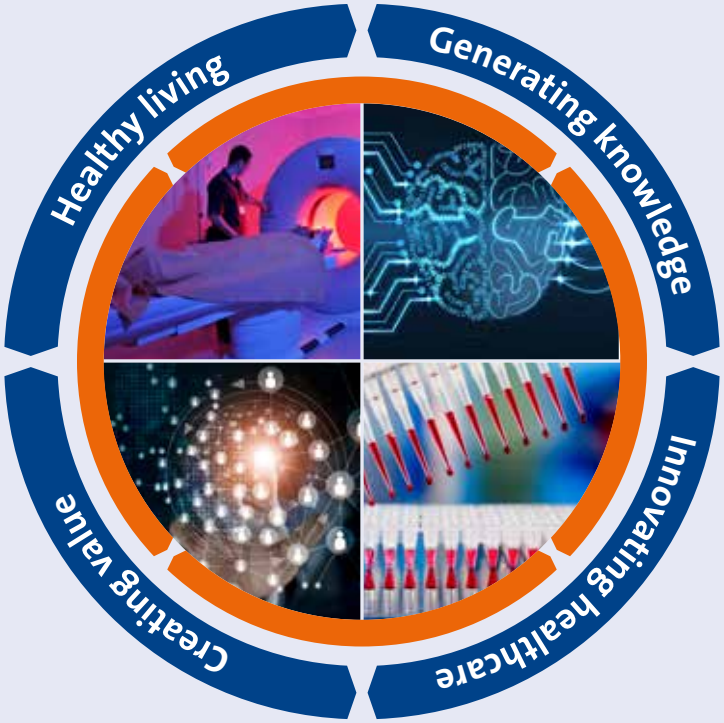
Circle of Innovation: Hybrid medical imaging and molecular imaging

EARLY DETECTION DISEASE

+ We are the only university medial centre in the Netherlands with a PET-MRI used for clinical care which improves tumour detection and therapy monitoring in patients with malignancies.
+ Recent literature shows that a digital PET-CT has an exceedingly higher sensitivity for the detection of small laesies. Currently we are initiating research in order to visualise the implications for patient care.
+ Based on the different metabole characteristics of a certain tumour, patients are considered elibible for a particular treatment: think of the treatment for neuroendocrine tumours using Lu-octreotaat.

OPTIMISING CARE IN THE REGION THROUGH IMPLEMENTATION OF NEW SENSITIVE TECHNIQUES

+ We are the sole centre in the Netherlands where staging of advanced prostate carcinoma is possible through PSMA-PET-MRI.
+ Our expertise and new diagnostic tools are available to all patients in the region due to our close collaboration with hospitals affiliated to the oncologic network OncoZON.
+ We contribute to generating new guidelines.



INNOVATIVE RADIOPHARMACEUTICALS AND NEW APPLICATIONS OF MOLECULAR IMAGING FOR IMPROVED PATIENT CARE

+ We use artificial intelligence models such as 'PET-iomics' to estimate prognostic factors and individualise therapy management.
+ In cooperation with Maastro, we develop and implement theranostics (diagnostics and therapy on molecular level) to predict factors for recidive head and neck tumours.

IMPROVED PATIENT TREATMENT USING SENSITIVE TECHNIQUES

+ Highly sensitive detection of molecular markers which are targets for new therapies, is possible through the results of our 'Pet iomics' and 'thearnostics'. New therapies are for example immune therapy or Luthetium therapy for prostate carcinoma and neuro-endocrine tumours.
+ Using early detection of therapy response with 'state-of-the-art' sensitive instruments we improve patient outcome.

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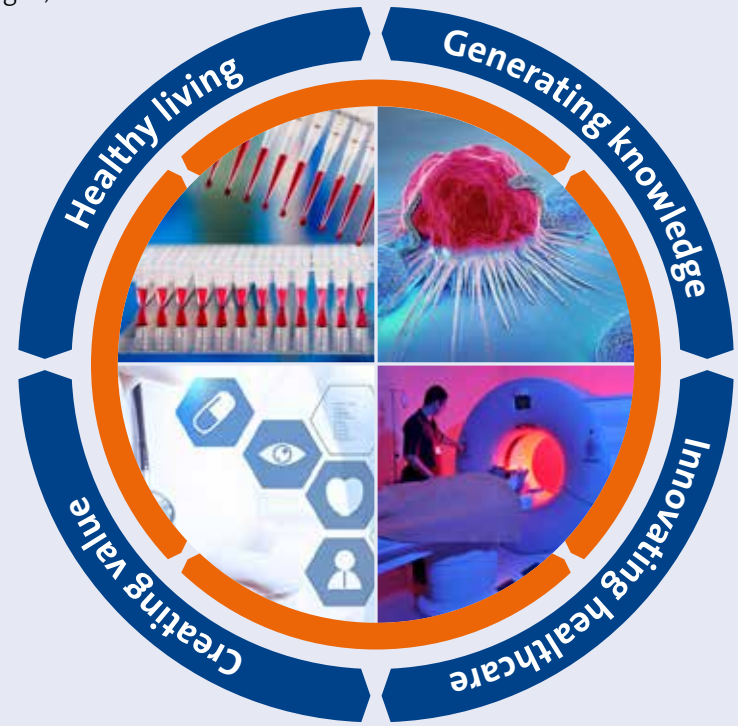
Circle of Innovation: The tumour microenvironment: imaging and targeting

RISK FACTOR IDENTIFICATION

+ The tumour microenvironment effects the success of current cancer treatments.
+ The tumour microenvironment, e.g. immune-privileged, hypoxia, necrosis, metabolism, is a characteristic of solid tumours and the topic of our research, valorisation and education.
+ We showed that the specific tumour microenvironment is a unique therapeutic opportunity.



INVESTIGATING THE TUMOUR MICROENVIRONMENT

+ We develop and use clinically relevant (3D) in vitro assays and in vivo models to investigate tumour microenvironment.
+ We explore innovative approaches to target the tumour using e.g. genetically modified non-pathogenic anaerobic Clostridium, hypoxia-activated prodrugs and immunotherapy.
+ We exploit the altered metabolism and immune system. We investigate influence of e.g. microbiome, nutrition on the microenvironment.

VALORISATION AND EDUCATION

+ We obtained prestigious (inter)national funding (some of them in collaboration with companies) to develop novel agents and test clinical treatments (e.g. ERC advanced, ERC Proof of Concept, Horizon 2020, NWO).
+ Knowledge dissemination is accomplished via development and execution of education.
+ Wide dissemination occurs also via animations (Immunocytokines, HAP, Nitroglycerine, Clostridium, Chloroquine).

IMAGING AND THERAPY

+ We have developed new hypoxia imaging markers (HX4 and radiomics) and tested it from bench to bedside.
+ We have developed novel therapies based on hypoxia-activated prodrugs and genetically engineered anaerobic bacteria.
+ We test repurposed/orphan drugs in clinical trials (e.g. Chloroquine).
+ We have unique companion biomarkers for patient stratification, some of them using artificial intelligence and unique new original treatment tested in patients.

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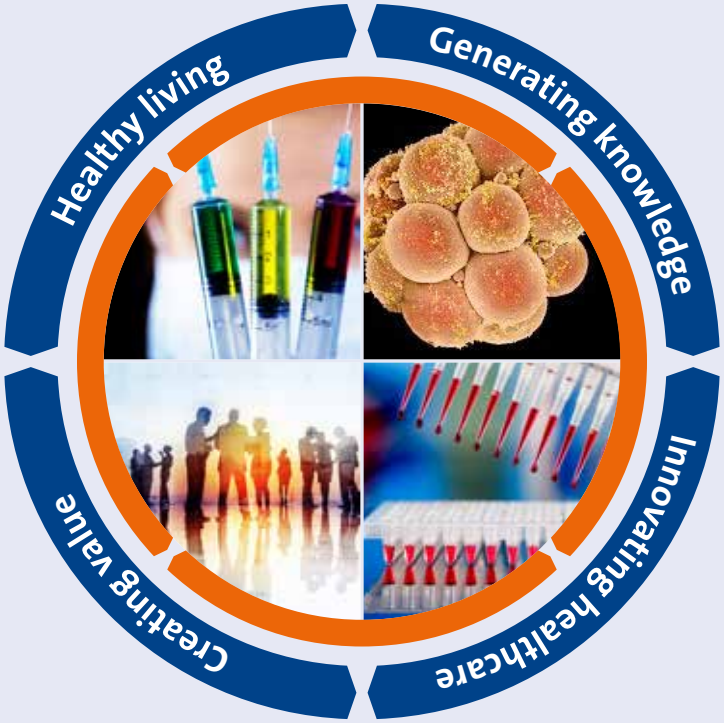
Circle of Innovation: Cell therapy

SURVIVAL BY IMMUNOTHERAPY AND OPTIMAL QUALITY OF LIFE

+ The development of innovative immunotherapy creates new treatment options for cancer patients with 'more cure, less toxicity'.
+ We actively investigate long-term treatment effects and their influence on quality of life.
+ By our research- and clinical activities we attract (inter)national students, scientists and patients.

USE THE IMMUNESYSTEM TO SPECIFICALLY TARGET CANCER

+ We develop 'haploidentical stem cell transplantation'.
+ We investigate which genetic factors of the donor associate with optimal anti-tumour responses and minimal toxicity.
+ We study how natural killer cells can be optimally used against a variety of cancers by investigating the effect of the tumour-microenvironment on natural killer cell function and homing.



DISSEMINATION AND COMMERCIALISATION BY COLLABORATION

+ We combine bench to bedside research, top-clinical care and multidisciplinary collaboration.
+ We are involved in training a new generation of professionals.
+ CiMaas started as spinout of Maastricht UMC+ realising cell therapy based on preclinical Maastricht UMC+ research.
+ Developments are shared with the public, partly via the Cancer Research Foundation Limburg.

INNOVATIVE DIAGNOSTICS AND IMPLEMENTATION OF NEW TREATMENTS

+ We develop a high-throughput diagnostic platform to predict immune cell reactivity by single molecule sequencing.
+ We coordinate the first multicentre study on donor stem cell transplantation with natural killer mismatch in myeloma patients.
+ We develop combination therapy with 'haploidentical stem cell transplantation', natural killer cell infusion and an antibody.

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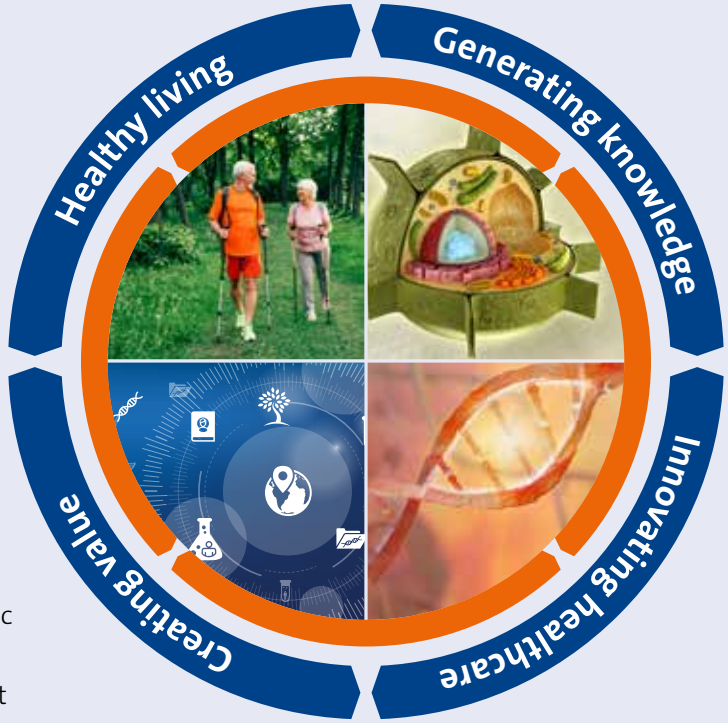
Circle of Innovation: Sufficient energy: a central role for mitochondria

A LIFE FULL OF ENERGY AND POWER

+ Energy capacity in cells differs among people and declines by age.
+ We use genetically defined differences to predict severe side effects of cancer treatment and pain.
+ We test if healthy, autologous muscle stem cells can treat myopathy in patients with a mitochondrial DNA mutation.
+ We test the potential of these cells to prevent or treat cachexia in cancer.

PREVENTION BY CLINICAL GENOMICS

+ We are world-leading in preimplantation genetic diagnosis for mitochondrial DNA disease.
+ We link genomic with biochemical and clinical data, including High-Resolution MRI, to improve prognostic predictions.
+ By means of prognostic predictions during treatment of cancer, we are taking into account the preservation of function.



MOLECULAR (STEM)CELL BIOLOGY IS FUNDAMENTAL

+ We investigate mitochondrial disease mechanisms in (stem)cells of patients and zebrafish, because of their rapid ex vivo embryogenesis.
+ We determine differences in mitochondrial energy metabolism between normal embryonic and abnormal cancer development.
+ Potential new targets for treatment can be tested in the same cellular and zebrafish models.

PREVENTING THE TRANSMISSION OF MITOCHONDRIAL DISEASES

+ We use next-generation sequencing to characterise genetic defects in patients.
+ Genomics is the key for identifying family members at risk and for prevention, medication, nutrition and lifestyle advice, which in some cases can be life-saving.
+ Parents at risk of having an affected child are offered prenatal diagnosis, preimplantation genetic diagnosis or, in the UK, mitochondrial replacement therapy.

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Circle of Innovation: Cancer cachexia

IMPROVEMENT OF PHYSICAL CONDITION TO IMPROVE POSTOPERATIVE FUNCTION

+ After healing, a long process of recovery is necessary to restore the original level of fitness prior to illness, operation and healing.
+ Increase of the pre-operative condition by physiotherapy improves both the condition after surgery as well as the effectiveness of the operation.
+ The level of physical condition of the patient before the operation is measured by the adoption of physical activity, nutritional status and weight with app-based technology.

SHARING OF BEST PRACTICES

+ Using teleconsulting between doctors in different centres we share knowledge, experiences and expertise quickly. In that way, we optimise the treatment of the patient.
+ We founded the company AdJuTec, fully dedicated to the development of personalised therapeutic tumour vaccines.
+ We have founded ONCOCARE, a Euregional cooperation for innovation in care and research.

PERSONALISED TUMOUR MODELS

+ Using organoid tumour models we study the biological effect of a tumour on the body. Organoids retain the original features of the tumour.
+ We characterise the effects of tumour organoids on the body, focusing on fat and muscle breakdown, liver function, and the immune system.
+ We use pre-clinical in-vivo models and use stable isotopes among others in combination with mass spectrometry imaging.

VACCINATION AGAINST CANCER AND CACHEXIA

+ Using organoids we identify new, patient-specific therapeutic targets, which help the body's immune system to clean up the patient tumour cells and to reduce the degree of cachexia. Thus the condition of the patient is better preserved.
+ We do this within our company AdJuTec.

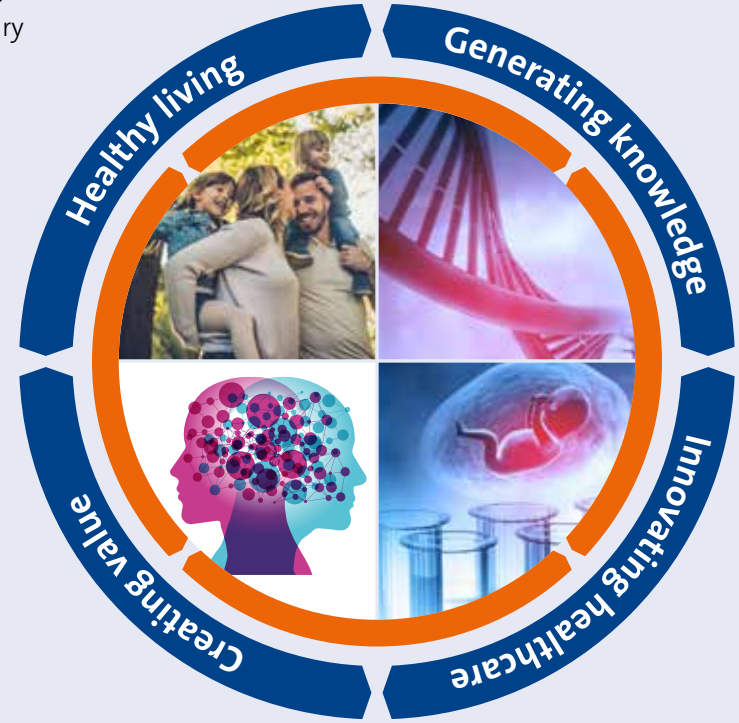
Circle of Innovation: Reproductive decision support in hereditary cancer

IMPROVEMENT OF REPRODUCTIVE DECISION-MAKING PROCESS

+ The online decision aid offers an explanation about the different options, such as preimplantation genetic diagnosis and prenatal diagnosis, to prevent the high risk (50%) of transmitting the mutation for hereditary cancer to offspring.
+ Providing couples timely and structurally with information regarding the available reproductive options was proven to be useful in improving the reproductive decision-making process.

FURTHER DEVELOPMENT AND IMPLEMENTATION

+ Implementing the online decision aid on the internet as a freely accessible tool to facilitate the dissemination of the tool.
+ The decision aid will be implemented in the daily onco-genetic counselling within all nine clinical genetic departments in the Netherlands.
+ The decision aid is effective in improving the quality of the reproductive decision while enhancing, not replacing, the counselling by healthcare providers.



INFORMED DECISION-MAKING

+ Our research provided insights into the reproductive decision-making process of patients in hereditary cancer by the use of qualitative and quantitative research approaches.
+ Knowledge on reproductive decisional motives and considerations guided the development of the decision aid.
+ Extending and adapting the decision aid for other hereditary indications. By increasing the range and effectiveness of the tool we expect to optimise the overall impact of the decision aid.

ONLINE DECISION AID

+ Reproductive decision support in hereditary cancer, such as an online decision aid, facilitates informed decision-making and minimizes the short and long term negative impact regarding reproductive decision-making among couples.
+ 14% of our participants made an informed reproductive decision at baseline which increased to 58% three months after reviewing the decision aid.

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Circle of Innovation: Preservation of function through prediction models

BETTER SELECTION FOR TREATMENT

+ Preservation of function is important for elderly patients.
+ Elderly patients often suffer serious complications from cancer treatment and a large number cannot complete the treatment.
+ Prediction models can be helpful in shared decision-making leading to an optimal balance between survival and preservation of functions.

PREDICTIVE FACTORS FOR SURVIVAL AND PRESERVATION OF FUNCTION

+ The group of elderly cancer patients is heterogeneous which makes treatment complex.
+ Our research focuses on identification of patient characteristics that are predictive for treatment tolerance, survival and preservation of function.

PREDICTION MODELS AND DECISION AIDS FOR ELDERLY PATIENTS

+ Research results are used to develop prediction models.
+ The prediction models help doctors and patients to choose a treatment that initiates an optimal balance between survival and preservation of functions.
+ This results in safe and cost-effective healthcare for elderly cancer patients.

SURVIVING WITH PRESERVATION OF FUNCTION

+ Our research leads to identification of predictive patient characteristics which culminates in better shared decision-making with patients.
+ The prediction models create an instrument for geriatric screening.
+ This results in better identification of patients who are at increased risk for treatment complications.

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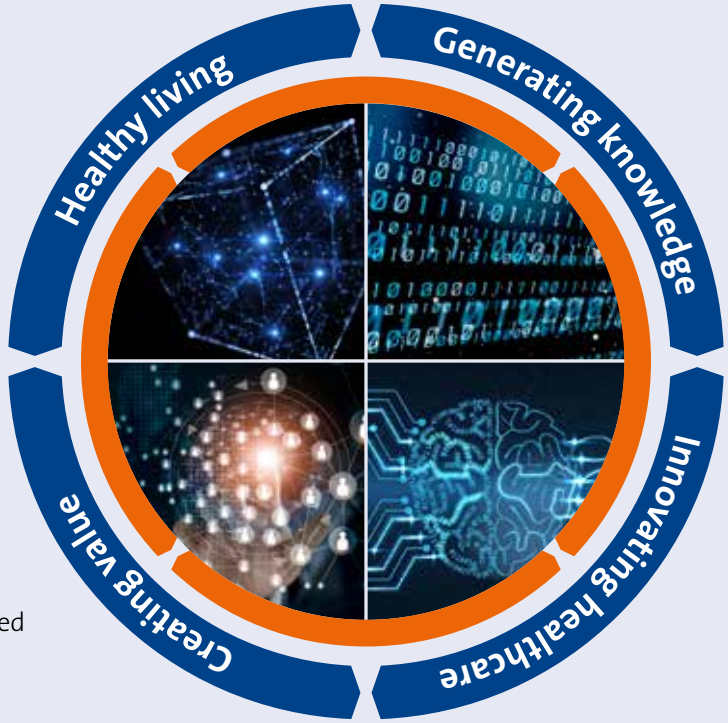
Circle of Innovation: Radiomics: a revolutionary approach to use imaging in medicine

RADIOMICS FOR DETECTION AND PREVENTION

+ Radiomics, invented in Maastricht in 2012, is a common technique worldwide to analyse medical images.
+ The D-lab develops radiomics signatures to systematically analyse medical images for detection and prevention of cancer and chronic diseases.
+ Radiomics comes with large volumes of image data.
+ Early detection and disease prevention improves disease management, increases survival chances and reduces healthcare costs.



RADIOMICS: LINK WITH BIOLOGY

+ We develop techniques to manage large volumes of image data.
+ We correlate gene expressions using radiomic features to predict treatment outcome.
+ The D-lab developed the methodology of distributed learning: medical images of multiple hospitals are analysed centrally without data leaving the hospital.
+ We apply the principle of radiomics also on tissue, e.g. to determine the texture using digital pathology slices.

VALORISATION

+ The D-lab has an excellent track record in high impact publications and grants.
+ Cooperation with industry partners Onco-radiomics, Aquilab, Varian and Siemens leads to CE/FDA approved solutions for worldwide implementation.
+ Radiomics has an international Marie Curie Training Network.
+ Animations are developed for education and communication (radiomics, distributed learning).

RADIOMICS IN REGULAR HEALTHCARE

+ The D-lab successfully applies radiomics in several imaging techniques, ranging from conventional X-ray to advanced CT and MRI.
+ We work according to the FAIR principle: data are re-used and connected to healthcare and clinical research.
+ We develop an ontology to standardise healthcare terms from different countries into a machine-readable format.

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Circle of Innovation: Multifactorial decision support systems for precision medicine

OPTIMAL TREATMENT FOR EVERY PATIENT

+ The increasing diagnostic and therapeutic options for cancer treatment complicate clinical decision making.
+ The optimal treatment for a patient depends on medical information and individual preferences.
+ Multifactorial decision support systems enable such treatment by providing specific tumour characterization, diagnosis and prognosis.
+ Multifactorial decision support systems increase patient involvement to give patient-specific preservation of function.

BRINGING MULTIFACTORIAL DECISION SUPPORT SYSTEMS TO THE CLINIC

+ Multifactorial decision support systems can assess cost-effectiveness of cancer treatment.
+ We cooperate with clinicians, health insurance companies and the industry to manifacture applications, ready for use worldwide.
+ The prediction models are published open source on www.predictcancer.org.
+ We have multiple animations concerning cancer treatment made publicly available for education and communication.

INNOVATIVE BIG DATA APPROACH

+ We investigate deep learning methods to build models that integrate clinical, functional, genetic and imaging information.
+ We develop privacy preserving distributed learning methods to facilitate analysis of multi-institutional data, without data leaving the hospital.
+ We perform unique research on mitochondrial DNA.
+ We use virtual data to improve our models.

DEVELOPING MULTIFACTORIAL INDIVIDUALISED DECISION SUPPORT SYSTEMS

+ We combine re-use of existing data, with patient care data and clinical research.
+ We create an individualised digital patient avatar based on models.
+ We validate our multifactorial decision support systems in prospective cohorts.
+ The multifactorial decision support systems assist in decision making when randomised studies are lacking.

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Circle of Innovation: Quality of life after radiotherapy and cancer

LIMITING ADVERSE EFFECTS OF TREATMENT

+ Maastricht UMC+ distinguishes itself for its focus on the prevention of adverse effects and therefore the promotion of maintaining functional capacity.
+ ZON-PTC will be one of the three proton therapy centres in the Netherlands.
+ Proton therapy allows a much more accurate radiation of tumours while sparing the surrounding healthy tissue.

MAINTAINING FUNCTIONAL CAPACITY FOR A BETTER QUALITY OF LIFE

+ Maastricht UMC+ conducts clinical trials to reduce the number or severity of treatments. This prevents adverse effects and also cuts the costs.
+ Maintaining functional capacity results in a better quality of life and earlier return to employment.
+ Maastricht UMC+ created several spin-offs in the field of oncology e.g. CiMaas, Radiomics BV.
+ Knowledge and innovations are shared via the OncoZON network.

HOW DO WE MAP THE CHARACTERISTICS OF TUMOURS?

+ The complexity of tumours poses a challenge to effective treatment. For example, there is not only one type of lung cancer, but there are many different types.
+ Maastricht UMC+ conducts fundamental research into the molecular characteristics of tumours.
+ In addition, we use imaging to characterise tumours in a unique way; we call this radiomics.
+ Using big data, imaging is combined with patient databases and molecular data to specify tumours.

INNOVATIVE THERAPIES AND PREDICTION MODELS

+ Cancer is the leading cause of death in the Netherlands.
+ Maastricht UMC+ creates prediction models to select a treatment for each individual patient that will give the highest tumour control and fewest adverse effects possible.
+ We are able to predict, for instance, which patients will benefit from a sophisticated treatment such as proton therapy within ZON-PTC.
+ Maastricht UMC+ tests innovative combinations of chemotherapy, immunotherapy and radiotherapy.

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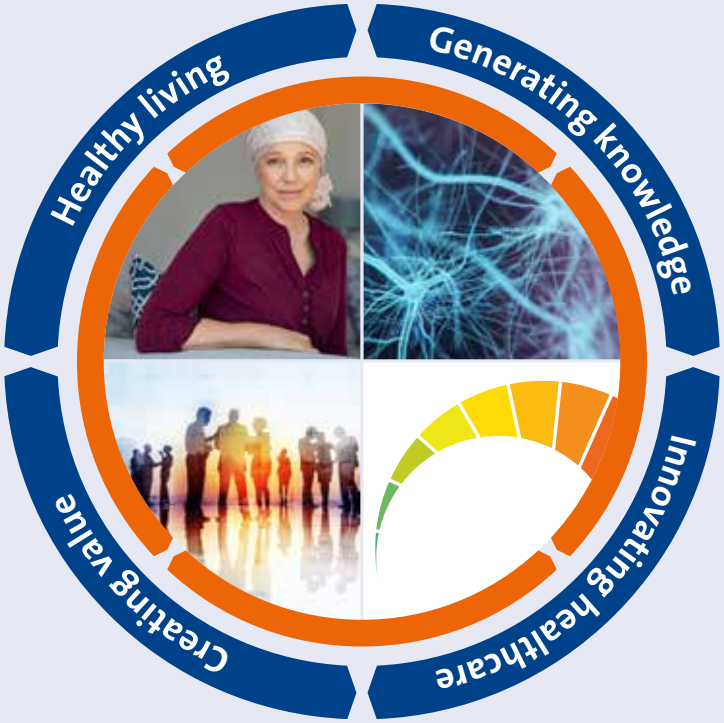
Circle of Innovation: Treatment of pain in patients with cancer

PREVENTION OF PAIN IN CANCER

+ Consequent measuring of pain in an in- and outpatient setting leads to better treatment.
+ We have dedicated pain specialists for pain in cancer patients.
+ Our inpatients have 24/7 access to pain service; in the outpatient clinic within 48 hours.
+ Preservation of function is the focus of treatment of pain in cancer. This improves quality of life of patients with cancer.

LOWERING PAIN LEVELS

+ Prediction models help to predict treatment success and are used in the Netherlands.
+ Our knowledge of pain in cancer is transferred via the OncoZON.
+ Members of our team are involved in the updates of the different National Guidelines on Pain in Cancer.



INSIGHT IN PAIN MECHANISMS

+ The pain laboratory of Maastricht UMC+ investigates pain in cancer. Studies concentrate on mechanisms of central and peripheral sensitization.
+ We investigate which intervention is most successful in treating pain in pancreas cancer.
+ We develop a prediction model for patients with head-and-neck cancer pain.
+ We investigate the effectiveness of different opioids in bone cancer pain.

RATIONAL USE OF INTERVENTIONS

+ Pain is continuously monitored by Electronic Sampling Methods as part of the treatment of pain in cancer.
+ This makes pain visible and enables us to intervene early.
+ The pain team supports in making considerations in case of complications. Based on this advice decisions about feasibility of interventions are made.

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Circle of Innovation: Timely integration of palliative care

MAINTENANCE OF AUTONOMY AND 'BEING IN THE LEAD'

- The patient is in the lead in creating his/her palliative treatment plan to enable the patient to function according to his/her wishes.
- This results in preservation of function, better quality of life and patient satisfaction.
- We treat physical (e.g. pain, dry mouth, dyspnoea), psychological, social and existential symptoms.

GENERALIST IF POSSIBLE, SPECIALIST IF NECESSARY

- In palliative home care groups (PaTz) we work with general practioners and community nurses to improve palliative care in home situations by promoting collaboration and enlarging knowledge.
- Our palliative care consultation team has an advisory role for all healthcare professionals in the region.
- We implement integrated palliative education in the basic medical curricula throughout the Netherlands and palliative care in education for nurses and carers in Limburg and Southeast Brabant.

WHO, WHEN, WHAT?

- By continuously measuring and integrating the four domains - physical, psychological, social and existential - we identify and treat palliative care needs of patients.
- We perform randomised controlled medication trials to find the most effective treatment at cost of minimal side effects in this vulnerable patient group.
- We use and investigate Advance Care Planning for timely conversations concerning the end of life.

INTEGRATION PALLIATIVE MEDICINE

- In Maastricht UMC+ we integrate disease centred and symptom centred care in an early phase in cancer, chronic illnesses and legal incapable patients.
- By research in Advance Care Planning optimal integration is being promoted.
- We investigate methods for optimal treatment of pain, dry mouth and dyspnoea.

Maastricht UMC+ Circle of Innovation®

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More knowledge, better life

Circle of Innovation: Prevention of futile treatment at the end of life

FOCUS ON OPTIMAL QUALITY OF LIFE AND QUALITY OF THE END OF LIFE

+ At the end of life, both an optimal quality of life and quality of dying are very important.
+ Although palliative chemotherapy or radiotherapy can increase duration of survival, it might also decrease quality of life.
+ Early communication about goals and effects of treatment can lead to a better quality of life and end of life.

PREVENTION OF FUTILE TREATMENT LEADS TO AN OPTIMAL QUALITY OF LIFE AND END OF LIFE

+ Research leads to increased awareness of (possible) futile treatment among oncologists.
+ This results in alertness of early communication with patient and family, and in selected cases early termination of aggressive futile treatment at the end of life. Consequently making an optimal quality of life and end of life possible.

HOW CAN FUTILE TREATMENT AT THE END OF LIFE BE PREVENTED?

+ Our research has shown that futile treatment at the end of life is common.
+ Current research focuses on reasons for futile treatment and what actions can be undertaken for improving doctor-patient communication about this topic, thereupon prevent futile treatment at the end of life.

BETTER INFORMATION AND COMMUNICATION

+ We now have insight into reasons for futile treatment at the end of life.
+ Awareness creates opportunities for discussions about offering life-sustaining treatments at the end of life.
+ Skills for communication about this topic are necessarily in medical training.

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Circle of Innovation: Tertiary prevention of colorectal cancer

MAASTRICHT UMC+ CONTRIBUTES TO TERTIARY PREVENTION OF CANCER

+ We improve awareness of lifestyle for preservation of function among survivors, healthcare professionals and trainees.
+ We contribute to improved cancer survivorship with evidence-based targeted interventions and improved pharmacotherapy.
+ As part of the Cancer Prevention Europe consortium, we embrace a coordinated approach to cancer prevention, including tertiary prevention.

LIFESTYLE ADVICE AND IMPROVED TREATMENT FOR IMPROVED CANCER SURVIVORSHIP

+ Our research contributes to lifestyle recommendations for cancer survivors and to improved social participation and functioning of cancer survivors.
+ Our research contributes to bringing improved pharmaceutics to the market early.

UNDERSTANDING BIOLOGICAL MECHANISMS TO TARGET FUNCTIONING

+ We investigate nutritional, inflammatory and metabolic blood biomarkers to understand the influence of lifestyle factors on the quality of life and prognosis of colorectal cancer survivors.
+ We study brain metabolites and integrity to understand sedentary behavior affecting fatigue.
+ We generate data to predict side effects of cancer therapies.

INNOVATIVE PREVENTION STRATEGIES TO IMPROVE CANCER SURVIVORSHIP

+ We can identify colorectal cancer patients at an increased risk of future low quality of life to target these patients with tailored interventions.
+ We can develop targeted lifestyle interventions aimed at diet and physical activity to improve the quality of life and prognosis of colorectal cancer survivors.
+ We aim to detect early toxic effects of pharmaceuticals to improve cancer therapies.

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More about Maastricht Cancer Center
+ www.oncologie.mumc.nl
+ www.maastrichtuniversity.nl/research/school-oncology-and-developmental-biology
+ www.maastro.nl
+ www.oncozon.nl

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